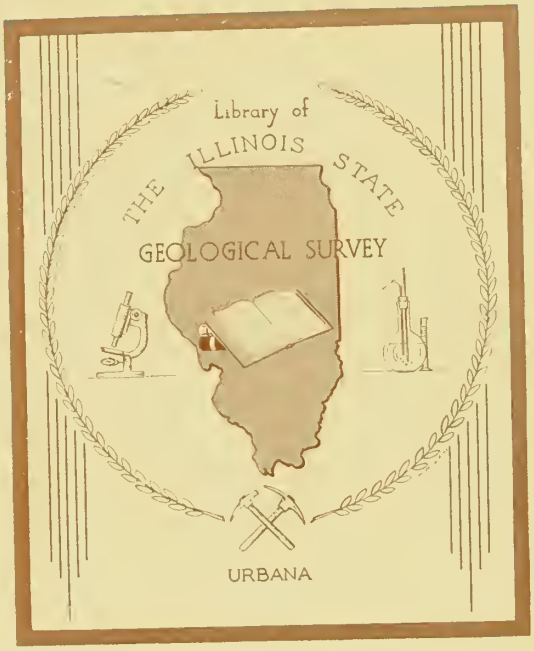

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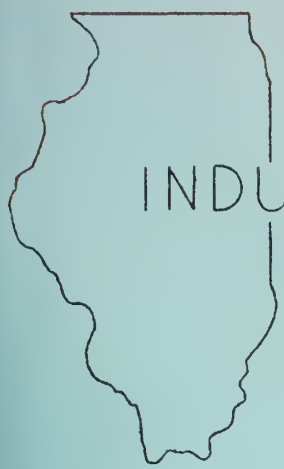
November, 1964



INDUSTRIAL MINERALS NOTES • No. 20

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CHEMICAL COMPOSITION OF SOME DEEP LIMESTONES AND DOLOMITES IN LIVINGSTON COUNTY, ILLINOIS

James W. Baxter

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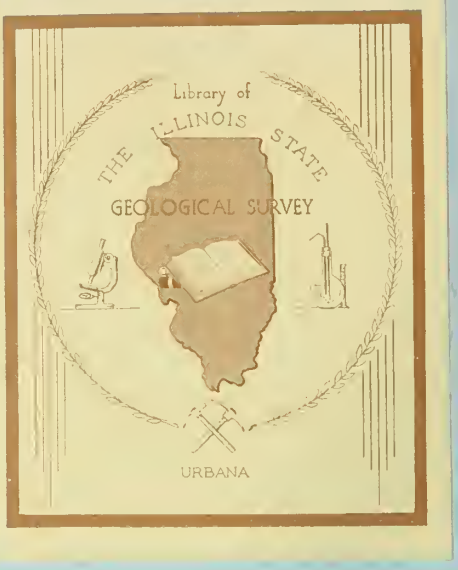
A B S T R A C T

Chemical analyses of dolomite and limestone from a diamond drill core taken near Forrest, Illinois, provide information that previously was unavailable for areas in which these formations are overlain by several hundred feet of other sediments and hence not subjected to weathering. The limestone and dolomite formations sampled in the drill core crop out and are quarried farther north.

In general, the composition of the formations, which occur above 1300 feet in the core, is similar to that of the outcropping rocks farther north except that the strata of the Galena Group in the well are principally limestone or dolomitic limestone whereas in northwestern Illinois they are mostly dolomite. The analyses show that the reef-type dolomite of Niagaran age is as high in purity in the subsurface as it is in the outcrop areas.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Niagaran age dolomite is quarried extensively at Chicago, Joliet, Kankakee, and other places in northeastern Illinois, and the dolomite and limestone of the Galena and Platteville Groups are worked at many places in northwestern Illinois. The chemical composition of these formations is reasonably well known where they crop out, but no data have been available as to their composition where they are overlain by several hundred feet of other rock and hence are protected from the effects of weathering and surface water. This has been a matter of interested speculation for some years.

The core of hole 2 drilled with a diamond drill by the Pennsylvania Drilling Company near Forrest, Illinois, in the SW¼ NW¼ NW¼ section 1, T. 26 N., R. 7 E., recently became available for analysis. Approximately 3 inches were taken from each foot for permanent storage. Fifteen samples, representing the various thicknesses and depths specified in table 1, were taken for chemical analysis by crushing and splitting the remaining three-fourths of the core. The samples therefore represent a virtually continuous section of rock. Those parts of the core that were not analyzed were either missing or were composed of very impure rock.

The uppermost materials encountered in the boring were clay and sand, which are glacial deposits and have a total thickness of 220 feet. Below them, 177 feet of rocks of Pennsylvanian age were chiefly sandstone, shale, and clay with some coals and thin limestones.

The shallowest thick carbonate rock was the Racine Dolomite. This formation and the underlying Waukesha and Joliet Dolomites are of Niagaran age. The Racine Dolomite was found at a depth of 397 feet and extended to 613 feet, giving it a thickness of 216 feet. Four samples were taken; some of the core was not analyzed for reasons previously stated. Table 2 shows that the samples vary considerably in composition. The high silica content of sample A is due to the presence of chert and that of sample D to silt, clay, and chert. Sample B, 24 feet thick, is quite pure dolomite and is of the reef type. There is also some reef-type dolomite in sample C. The purity of these samples is as high as that of the reefs in the Chicago outcrop area.

Sample E, representing the Waukesha Dolomite, is relatively high in silica and alumina, reflecting the presence of clay and silt. The Waukesha is 36 feet thick in the core.

Three samples, F, G, and H, represent the Joliet Dolomite, which is 168 feet thick. None of the samples has a high carbonate content. The silica and alumina present come from clay and silt. The Joliet is not greatly different from some of the outcropping Joliet in northeastern Illinois.

Samples J, K, L, and M are limestone of comparatively high purity from the Galena Group. Samples J and K contain 4 percent or less magnesium carbonate, but sample L contains about 10 percent and M about 7 percent magnesium carbonate. The fact that these strata are limestone is a departure from their usual character for they occur as dolomite in northwestern Illinois.

(Text continued on page 5.)

TABLE 1 - DATA ON SAMPLES FROM THE CORE OF PENNSYLVANIA DRILLING COMPANY HOLE 2, LIVINGSTON COUNTY

Sample	Geological formation	Thickness (ft)	Depth (ft)	Principal character
*		220.0	0.0 to 220.0	Clay and sand
*		176.8	220.0 to 396.8	Sandstone, clay, and shale
A	Racine°	21.2	396.8 to 418.0	Dolomite, cherty
*	Racine°	16.0	418.0 to 434.0	Dolomite, cherty
B	Racine°	23.8	434.0 to 457.8	Dolomite, white and gray, porous
*	Racine°	0.2	457.8 to 458.0	Shale
C	Racine°	57.6	458.0 to 515.6	Dolomite, white and gray, fine grained, partly porous
*	Racine°	8.8	515.6 to 524.4	Dolomite, cherty
D	Racine°	88.6	524.4 to 613.0	Dolomite, silty, clayey; some chert
*	Racine & Waukesha°	19.0	613.0 to 632.0	Dolomite, clayey; shaly partings
E	Waukesha°	25.3	632.0 to 657.3	Dolomite, pink and green; shaly partings
F	Joliet°	55.9	657.3 to 713.2	Dolomite, gray, porous
G	Joliet°	68.8	713.2 to 782.0	Dolomite, calcareous, gray
H	Joliet°	43.4	782.0 to 825.4	Limestone, dolomitic, gray, fine grained
*	Joliet,° Kankakee, & Edgewood	30.7	825.4 to 856.1	Limestone, cherty, shaly, sandy

TABLE 1 (continued)

Sample	Geological formation	Thickness (ft)	Depth (ft)	Principal character
*	Brainard	80.9	856.1 to 937.0	Shale and siltstone
*	Fort Atkinson	27.3	937.0 to 964.3	Limestone, clayey and shaly
*	Scales	68.5	964.3 to 1032.8	Shale
*	Dubuque+	1.8	1032.8 to 1034.6	Limestone, pyritic
J	Dubuque+	30.4	1034.6 to 1065.0	Limestone, gray; calcite filled vugs; fine grained
K	Wise Lake+ & Upper Dunleith+	59.0	1065.0 to 1124.0	Limestone, buff-gray, partly granular; shale partings
L	Middle Dunleith+	57.0	1124.0 to 1181.0	Limestone with dolomite mottlings, partly granular, gray
M	Lower Dunleith+ & Guttenberg+	28.5	1181.0 to 1209.4	Limestone, partly dolomitic; clay partings
N	Quimbys Mill,# Middle & Upper Nachusa#	37.9	1209.4 to 1247.3	Limestone, cherty; shale partings
O	Lower Nachusa#	14.5	1247.3 to 1261.8	Dolomite, cherty, mostly porous
P	Grand Detour#	29.2	1261.8 to 1291.0	Limestone, dolomitic, and dolomite; shale partings; some chert

* Not sampled because those parts of the core were either inadequate for a representative sample or the rock was very impure.
° Niagaran age dolomite
+ Galena Group
# Platteville Group

TABLE 2 - CHEMICAL ANALYSES OF DOLOMITES AND LIMESTONES*

Sample	Depth (ft)	Thickness (ft)	Geological formation	SiO_2 (%)	TiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	MgO (%)	CaO (%)	CO_2 (%)	$MgCO_3$# (%)	$CaCO_3$# (%)	$MgCO_3$ and $CaCO_3$ (%)
A	396.8- 418.0	21.2	Racine	12.2	< 0.1	0.8	1.5	16.4	28.2	41.44	34.3	50.3	84.6
B	434.0- 457.8	23.8	Racine	1.1	< 0.1	0.5	0.8	19.6	32.5	46.38	41.0	58.0	99.0
C	458.0- 515.6	57.6	Racine	2.3	0.1	0.5	0.7	18.4	31.4	46.24	38.5	56.0	94.5
D	524.4- 613.0	88.6	Racine	27.8	0.30	5.6	2.06	12.5	19.4	28.55	26.1	34.6	60.7
E	632.0- 657.3	25.3	Waukesha	15.5	0.12	2.6	1.27	15.7	26.1	37.72	32.8	46.6	79.4
F	657.3- 713.2	55.9	Joliet	5.8	0.1	1.3	1.0	17.6	29.4	43.37	36.8	52.5	89.3
G	713.2- 782.0	68.8	Joliet	8.4	0.1	1.5	0.9	9.5	37.7	40.01	19.9	67.3	87.2
H	782.0- 825.4	43.4	Joliet	3.0	0.1	0.9	0.5	4.5	46.2	42.92	9.4	82.4	91.8
J	1034.6-1065.0	30.4	Dubuque	2.0	< 0.1	0.4	0.4	1.6	53.3	42.68	3.3	95.1	98.4
K	1065.0-1124.0	59.0	Wise Lake & Upper Dunleith	< 0.5	< 0.1	0.50	0.30	1.9	53.0	43.34	4.0	94.6	98.6
L	1124.0-1181.0	57.0	Middle Dunleith	< 0.5	< 0.1	< 0.1	0.2	4.6	49.9	43.96	9.6	89.1	98.7
M	1181.0-1209.4	28.4	Lower Dunleith & Guttenberg	2.0	0.1	0.3	0.2	3.2	50.8	42.97	6.7	90.7	97.4
N	1209.4-1247.3	37.9	Quimbys Mill & Middle & Upper Nachusa	4.8	0.1	0.6	0.3	8.2	43.8	43.28	17.1	78.2	95.3
O	1247.3-1261.8	14.5	Lower Nachusa	4.7	0.1	0.1	0.3	19.4	31.0	45.13	40.6	55.3	95.9
P	1261.8-1291.0	29.2	Grand Detour	4.1	< 0.1	1.1	0.5	11.9	37.4	43.28	24.9	66.7	91.6

* Analyses by X-ray fluorescence method in the laboratories of the Illinois State Geological Survey.

Calculated from CaO and MgO.

Samples N, O, and P came from the Platteville Group. Sample N represents a 38-foot section that includes the Quimbys Mill Limestone and a portion of the Nachusa Formation. It is relatively pure, though the formations contain some chert that gives the sample a silica content of almost 5 percent.

Sample O, from 15 feet of the Nachusa Dolomite, owes its silica content to chert. It is mostly porous dolomite.

The oldest and deepest beds analyzed are upper strata of the Grand Detour Formation, sample P, which consists of limestone, dolomitic limestone, and dolomite. The rock contains shale partings and some of it is cherty. These characteristics are reflected in a combined silica and alumina content of 5 percent.